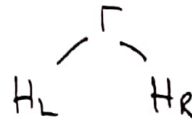
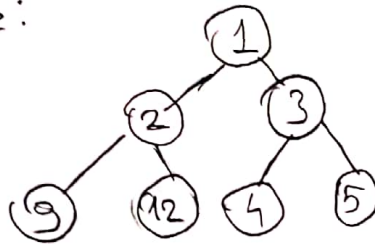


b) For each min heap, we have  $H_L \geq r$  and  $H_R \geq r$ , where  $r$  is the root. The general structure of the heap is:



Since  $H_L$  and  $H_R$ , left and right subtrees of root, are also min heap, all of the items in the leftmost position will be sorted, from root to leftmost, in ascending order.

For instance:



The items in the leftmost position on a level, from root to leaf are 1, 2, 9 and sorted in ascending order. Similarly, 1, 3, 5 is also sorted in ascending order.

Then, for every min heap, first  $L$  items in its preorder traversal will be sorted in ascending order; and in its postorder traversal, last  $L$  items will be sorted in descending order, where  $L = \#$  of completely filled levels.

Preorder: 1 2 9 12 3 4 5  
sorted  
 not sorted.

Inorder: 9 2 12 1 4 3 5  
 not sorted.

Postorder: 9 12 2 4 5 3 1  
sorted  
 not sorted

→ In conclusion, traversal of a heap is not sorted in those traversals.

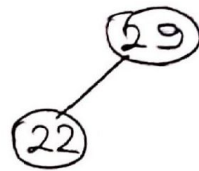
→ However, first  $L$  items of preorder and last  $L$  items of postorder

traversals are sorted.

insert 29



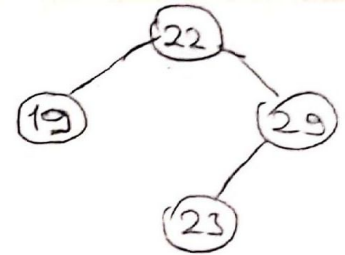
insert 22



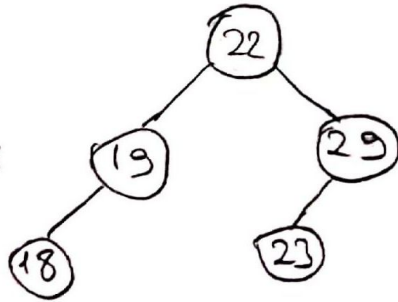
insert 19  
Single right  
rotate 22



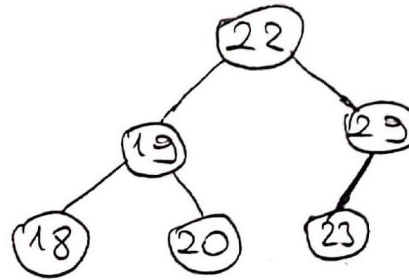
insert 23



insert 18

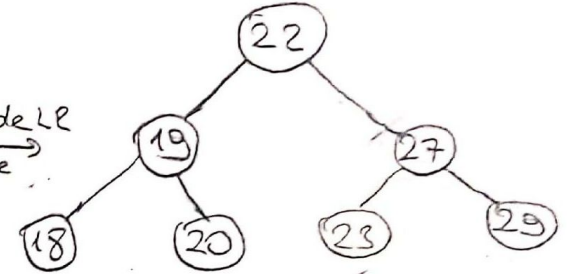


insert 20

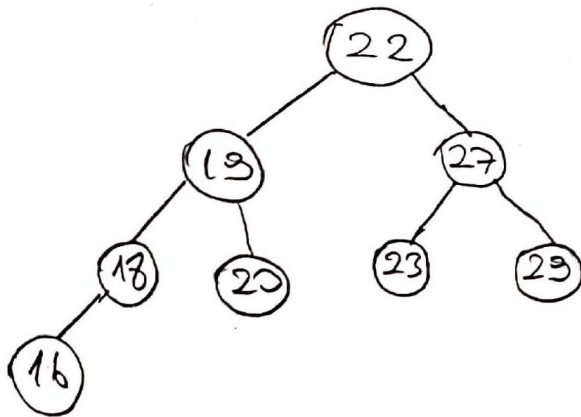


insert 27

Double LR  
Rotate 29

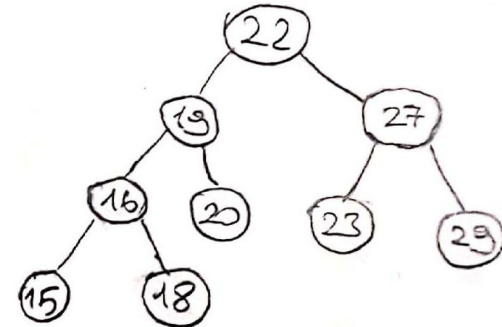


insert 16



insert 15

Single Right  
Rotate 18



insert 17  
Rotate LR Rotate  
19  
(Single L Rotate 16  
Single R Rotate 19)

